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(71) Applicant
The British Petroleum Company p.l.c.

(Incorporated in United Kingdom)

Britannic House, Moor Lane, London EC2Y 9BU

(72) Inventor
Hans Paul Hopper

(74) Agent and/or Address for Service
Malcolm MacLeod,
BP International Limited, Patents & Agreements Division,
Chertsey Road, Sunbury-on-Thames, Middlesex
TW16 7LN

(54) Fastening mechanism

(57) The mechanism is suitable for releasably fastening two opposing faces by movement of the faces towards each other and has a stem 10 and a sleeve 15 surrounding it. The stem 10 and sleeve 15 are mounted on separate plates 10A, 11 capable of relative axial movement. The stem and sleeve each have projections and adjacent profiles as shown and the outside of the sleeve 15 has a shoulder 31; the mechanism also has a receptacle 32 into which the stem and sleeve are to be fastened. With the projections 23, 24 and 27, 28 on the stem and sleeve 15 abutting, the sleeve 15 cannot enter the receptacle 32. However, since the stem and sleeve can move axially relative to each other, the stem and sleeve can be fastened into the receptacle by pushing the stem relative to the lock sleeve to reduce the diameter of the sleeve and can be released by pulling the stem relative to the sleeve. Figs. 2A–2D illustrate the fastening sequence as drive plate 10A is moved e.g. manually by a diver.

The mechanism may join parts to transmit hydraulic or electrical power and be used in subsea oil production.

In Fig. 3 a spring 40 regulates movement between plate 10A and plate 11—the separate stem spring 12 and sleeve spring 18 of Figs. 1–2D have been replaced by a single spring 39.

FIG.1.

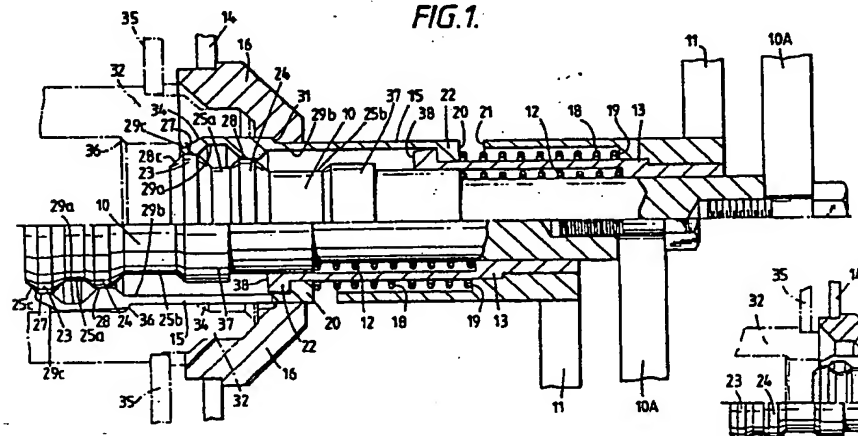
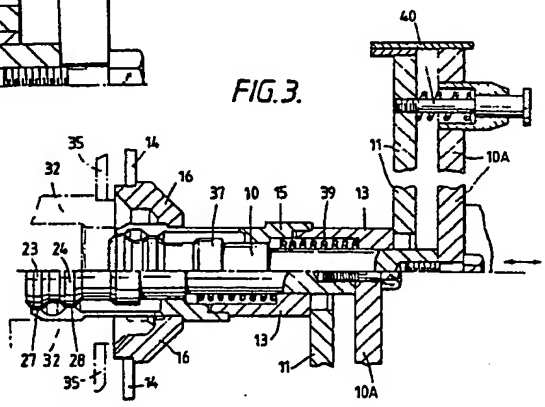


FIG.3.



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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FIG.1.

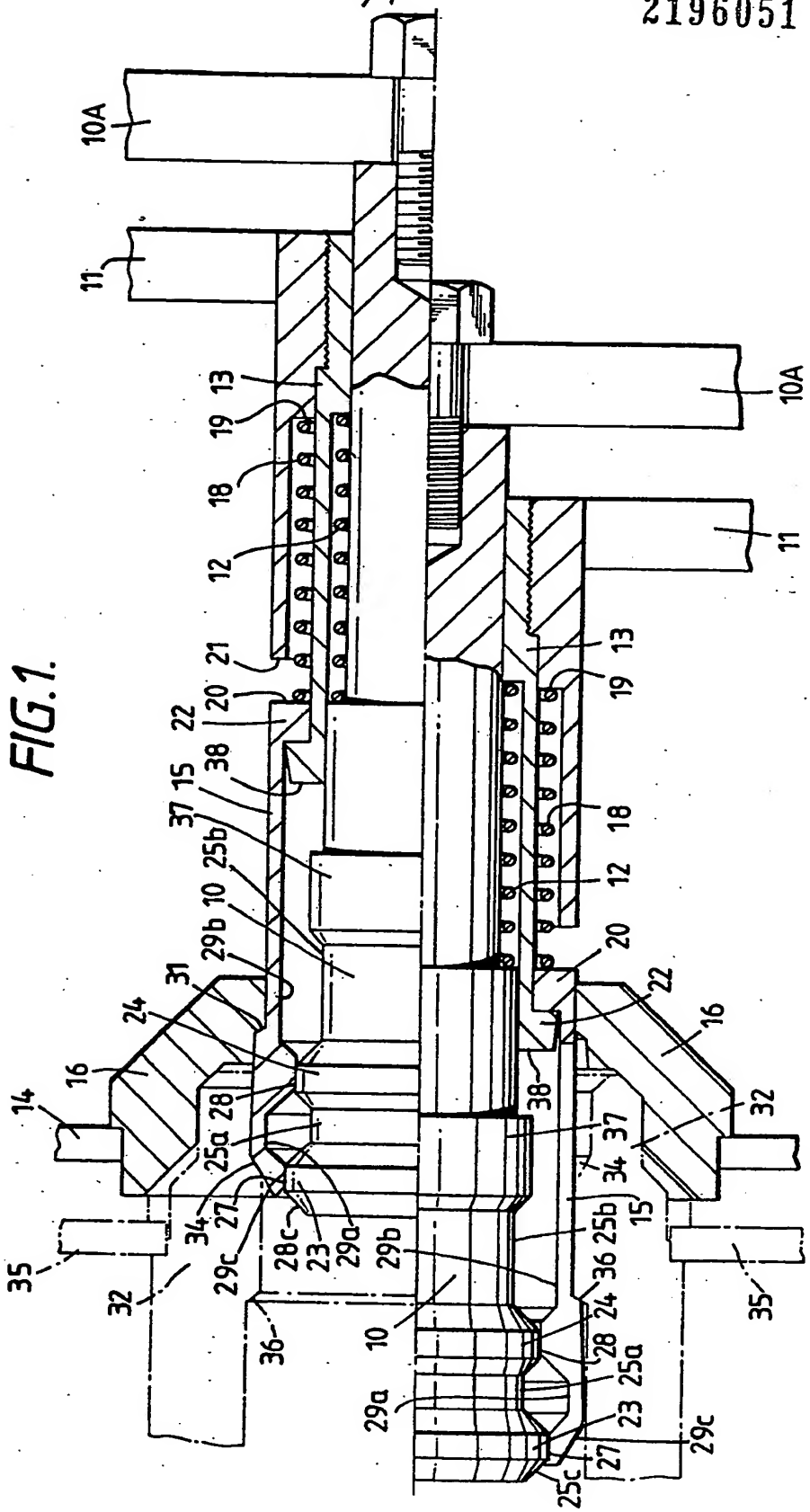

FIG. 2A.

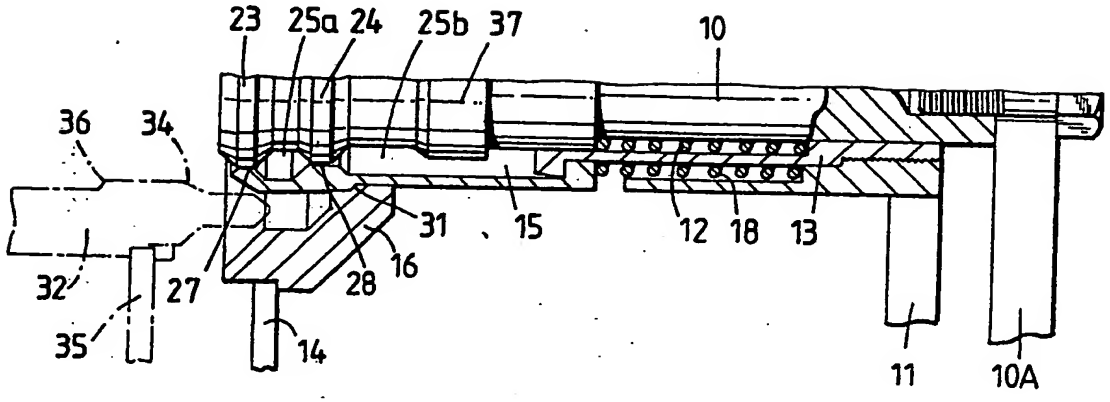
23
25a
24
25b
37
10
36
34
31
15
12
18
13
32
27
28
16
35
14
11
10A

FIG. 2B.

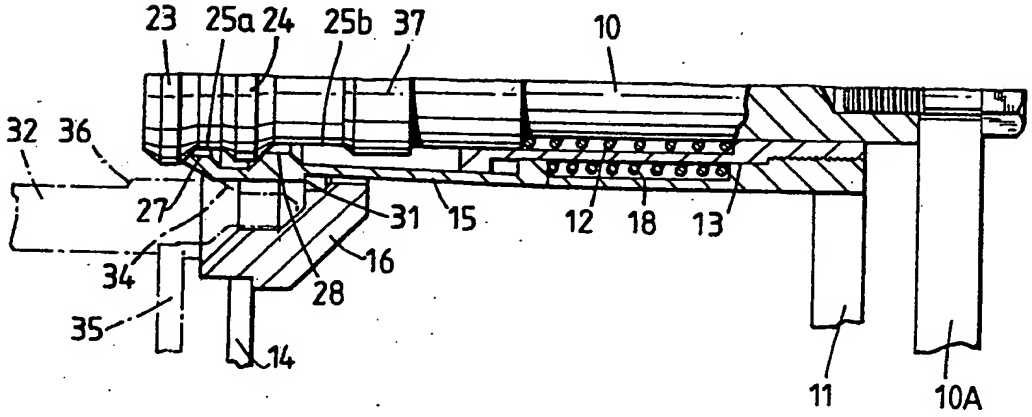
23
25a
24
25b
37
10
32
36
27
31
15
12
18
13
34
16
28
35
14
11
10A

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FIG.2C.

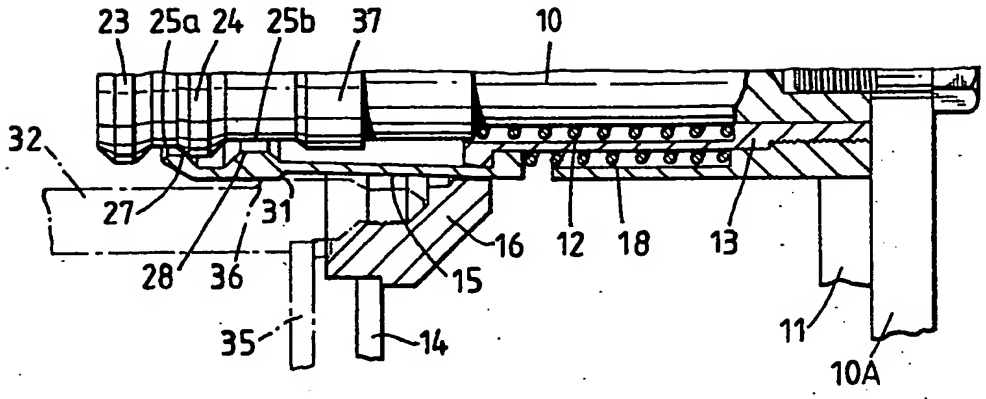

FIG.2D.

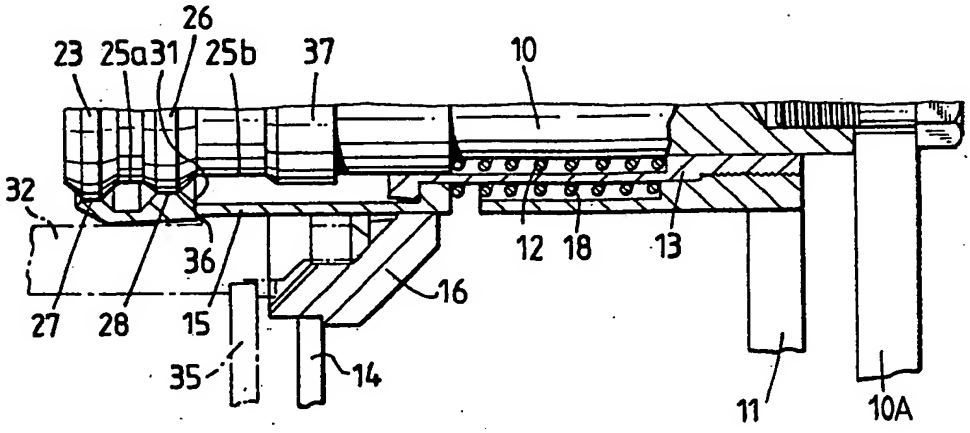

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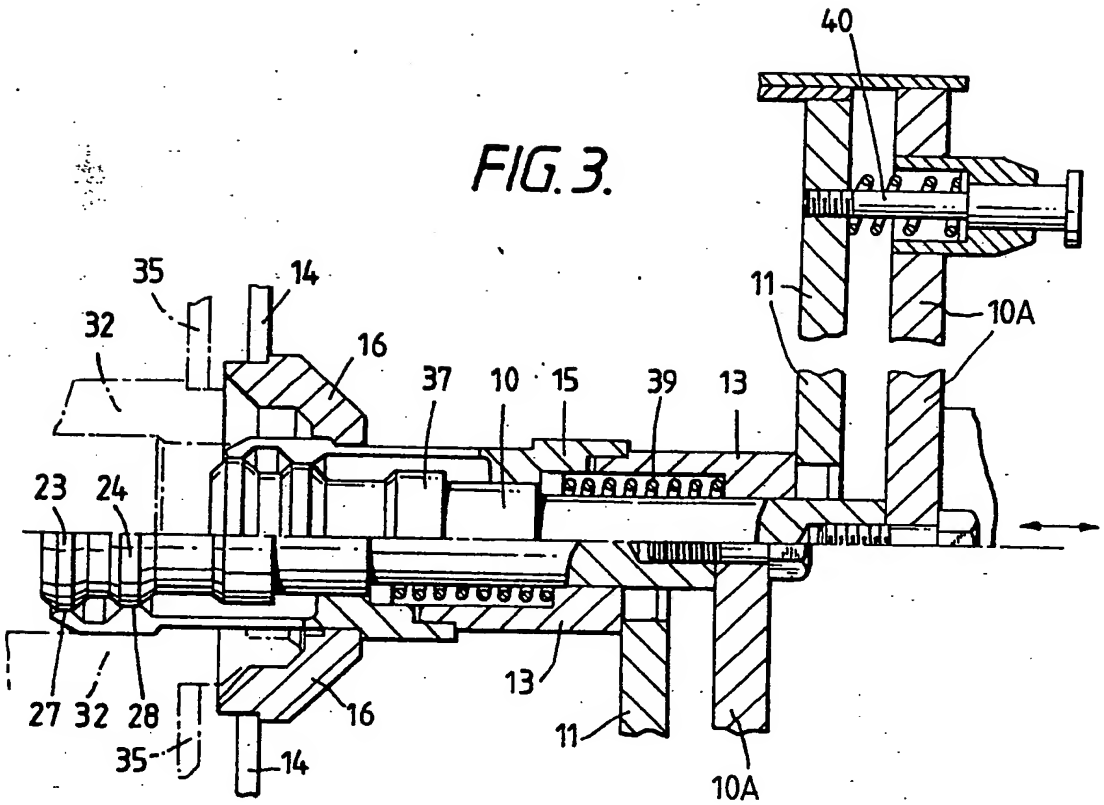
FIG. 3.



SPECIFICATION

Locking mechanism

This invention relates to a bayonet-type locking mechanism which locks by axial movement only and which is suitable for locking the underwater surfaces of parts used for sub sea oil production.

In sub-sea oil production systems there is frequently a need to join two parts firmly but releasably. One example of parts which need to be releasably locked are junction plates used to transmit material, e.g. hydraulic or electrical power between two parts. The specification of copending UK Patent Application No. 8622419 describes a junction plate comprising

(a) a plug capable of being moved into a receptacle remotely and under water

(b) a face plate for the plug having hydraulic and/or electrical outlets, this face plate having limited rotational movement about the axis of the plug and, preferably, limited linear movement along the axis of the plug, and

(c) a receptacle box for the receptacle having hydraulic and/or electrical inlets, this receptacle box having limited rotational movement about and limited linear movement along the two axes at right angles to the axis of the plug.

The plug and receptacle described in this copending application can be used, inter alia, to transmit hydraulic and/or electrical power across the parts of a modular control system for a subsea oil production template. The control system is described in UK Patent Applications Nos 8618307 and 8625195.

The face plate of the plug needs to be guided to and aligned with a corresponding face plate of the receptacle box and then locked to it by a locking mechanism which can be locked and unlocked by axial movement of the plug into and out of the receptacle box without any rotation of the plug or receptacle.

The present invention is concerned with such a locking mechanism.

According to the present invention a locking mechanism suitable for releasably locking two opposing faces by movement of the faces towards each other comprises:

(a) a stem extending from a drive plate, said stem having on its circumference two annular projections and an adjacent profile,

(b) a lock sleeve around the stem, extending from a base plate separate from the drive plate, said sleeve having on its inner surface two projections and adjacent profile and on its outer surface a shoulder,

(c) a receptacle for receiving the stem and lock sleeve having a step on its inner surface and having a mouth of slightly smaller diameter than that of the stem and lock sleeve when the projections of each abut, so that as the stem and lock sleeve reach the receptacle, the lock sleeve is displaced axially relative to the stem so that its projections enter the stem profiles and vice versa thereby allowing entry of stem and lock sleeve until the shoulder of the lock sleeve engages the step of the receptacle, the projections of the stem and lock sleeve returning to an abutting position to lock the sleeve and stem into the receptacle.

The invention is illustrated with reference to the accompanying drawing in which

Figure 1 is a section through a locking mechanism of the present invention, the top section above the centre line showing it in the unlocked position, and the bottom section showing it in the locked position.

Figures 2A, B, C and D show the stages in the locking sequence of the mechanism of Figure 1, and

Figure 3 shows an alternative embodiment of the mechanism of Figure 1.

Figure 1 shows a cylindrical stem 10 which is fixed to a drive plate 10A. (This drive plate may be the drive plate 41 of a plug as shown in Figure 1 of copending UK Patent Application No. 8624419). Stem 10 is free to slide through another base plate 11. (This base plate 11 may be the face plate 17 of a plug as shown in Figure 1 of copending Application No. 8624419). Stem spring 12 surrounds the end of stem 10, this spring being retained in stem housing 13 (which is rigidly fixed to base plate 11).

Parallel to base plate 11 is a floating plate 14 (This floating plate may also be part of the face plate 17 of a plug as shown in Figure 1 of copending UK Application No 8624419). Floating plate 14 is free to move axially independently of base plate 11. Floating plate 14 retains lock sleeve 15 between it and stem 10 by means of a bushing 16.

Lock sleeve spring 18 surrounds stem housing 13 being retained between shoulder 19 of the housing 13 and the end 20 of the lock sleeve 15. Lock sleeve 15 can move axially against or with the force of spring 18 between the outer end 21 of housing 13 and stop 22 at the inner end of housing 13.

The free end of stem 10 is frusto-conical. Its circumference has two annular projections 23 and 24 with a recessed profile 25a between them. There is also a recessed profile 25b to the right of the projection 24 and the frusto-conical end of stem 10 is equivalent to a recessed profile 25c to the left of projection 23. Lock sleeve 15 also has on its inside two annular projections 27 and 28 with a recessed profile 29a between them. There is also a recessed profile 29b to the right of projection 28 and the end of lock sleeve 15 is equivalent to a recessed profile 29c to the left of projection 27. The sides of the projections 23 and 24 slope into profile 25a as do the sides of projections 27 and 28 into profile 29a.

Stem 10 has a further annular projection 37,

which, as explained hereafter, acts with end 38 of stem housing 13 to limit movement of stem 10 when it is pulled, i.e. when it is moved to the right as shown in the drawing.

Lock sleeve 15 has a shoulder 31 on its outside.

Stem 10 and lock sleeve 15 fit into a receptacle which may be part of a receptacle box as shown in Figures 2 and 3 of UK Application No. 8624419. This receptacle is formed of a housing 32. Its mouth has a stop 34. The housing 32 is fixed to a base plate 35 (which may be the face plate of the receptacle box of Figures 2 and 3 of UK Application No. 8624419) and the other end of housing 32 is fixed to a back plate, not shown, (which may be the back plate of the receptacle box of Figures 2 and 3 of UK Application No. 8624419). The inner surface of receptacle housing 32 has a step 36 having a similar slope to shoulder 31 on the outer surface of lock sleeve 15.

Stem 10 is loaded by stem spring 12 to a neutral position by working against more powerful springs, e.g. spring 44 shown in Figures 1 and 1A of Application No. 8624419. Lock sleeve 15 is loaded by lock sleeve spring 18 to its extended position (ie against stop 22). Lock sleeve 15 is fingered so that its free end tends to move inwards towards the stem 10, unless prevented by projections 23,24 of stem 10 abutting against projections 27,28 of the lock sleeve. However, in view of the loading of stem spring 12 and sleeve spring 18, the normal rest position of the stem and lock sleeve is with the projections abutting.

It will be noted that projections 23 and 24 of the stem 10 are of different diameters, projection 23 having the larger diameter. Projections 27 and 28 of the lock sleeve 15 are of complementary different diameters, so that when the projections abut, the stem and lock sleeve are parallel. It will also be noted that the outside diameter of lock sleeve 15 adjacent the projections is slightly larger than that part of the receptacle mouth inside of step 34, when the projections of the stem and lock sleeve abut.

The unlocked position is shown by the top half of Figure 1; the locked position by the bottom half. It will be seen that stem 10 and lock sleeve 15 cannot move out of the receptacle housing accidentally because shoulder 31 of the lock sleeve is held by step 36 of the housing. Springs 12 and 18 hold stem 10 and lock sleeve 15 together to ensure that shoulder 31 and step 36 abut.

The locking sequence to get to the locked position is shown by Figures 2A, B, C, and D.

Since the position of stem, lock sleeve, base plate and floating base plate shown in Figure 1 is the normal rest position, the assembly is moved towards the receptacle in this configuration by moving the drive plate 10A (which, as previously stated, may be part of a plug). The end of stem 10 can begin to enter the receptacle 32 as shown in Figure 2A. Continued pressure on the drive plate will continue to move stem 10 into the receptacle mouth until the end of lock sleeve 15 reaches step 34 of the receptacle.

Step 34 halts the progress of lock sleeve 15 so that it is pushed back relative to stem 10 aginst the pressure of lock sleeve spring 18. Stem 10 continues to move forward so the net effect is that projections 27 and 28 of lock sleeve 15 are displaced into profiles 25a and 25b of stem 10.

As shown by Figure 2B, with the lock sleeve 15 thus reduced in diameter, it is free to move over step 34 so that the stem 10 and lock sleeve 15 can both move further into the receptacle.

Movement continues until the position shown in Figure 2C is reached. Spring 18 forces lock sleeve 15 forward. As drive plate 10A is driven forward, spring 44 shown in Figures 1 and 1A of Application No. 8624419 is compressed. Drive plate 10A and stem 10 are still moving into the receptacle, so drive plate 10A eventually contacts base plate 11. To ensure that lock sleeve 15 moves into the locking position, shoulder 24 makes contact with profile 27, thus minimising the effect of friction on spring 18. At this point shoulder 31 of lock sleeve 15 has almost reached step 36 in the receptacle mouth.

Continued driving pressure with the components in the positions shown in Figure 2C brings shoulder 31 up to step 36. Lock sleeve 15 is thus able to move outwards so that shoulder 31 engages with step 36. At this point the driving pressure is released. Stem 10 and drive plate 10A then move back a short distance relative to lock sleeve 15 and base plate 11 so that the assembly reaches the locked position of Figure 2D. This is caused by the action of the more powerful spring 44 shown in Figures 1 and 1A of Application No. 8624419.

Locking is thus effected by over pushing stem 10 into the receptacle, the actual locking being effected when the pushing stops and stem 10 is free to return to its normal position with respect to lock sleeve 15.

Release is effected by the reverse process. Drive plate 10A is pulled, pulling stem 10 with it. Since lock sleeve 15 is held by step 36, stem 10 is displaced axially with respect to lock sleeve 15. Stem 10 is free to move back until the annular projection 37 abuts against the end 38 of stem housing 13. Projection 28 of the lock sleeve thus enters profile 25a of the stem and projection 23 of the stem enters profile 29a of the lock sleeve. Lock sleeve 15 reduces in diameter allowing it to be withdrawn with the stem 10 as pulling on the drive plate continues. Once stem 10 and lock sleeve 15 are fully withdrawn from the receptacle, pulling can be stopped, wher-

eupon stem 10 and lock sleeve 15 return to their normal rest position. Withdrawal of drive plate 10A will continue until adequate clearance is achieved between the modules.

Release is thus, in effect, achieved by over pulling stem 10.

Since base plate 11 and floating base plate 14 may be part of a junction plate and the receptacle housing 32 part of a second junction plate it follows that locking is automatic by over pushing one junction plate against the other. Similarly unlocking is automatic, the first stage of the pulling of the junction plates apart serving to unlock the lock sleeve from the receptacle. Nevertheless, when locked, the plates cannot become separated by casual or accidental movement, since movement of drive plate 10A is totally independent of operating loads on the receptacle and junction plate.

Figure 3 shows a slightly modified embodiment of Figure 1. The actual stem 10 and lock sleeve 15 are identical to Figure 1 as is the basic mechanism of locking and unlocking. Figure 3 shows, however, the way drive plate 10A and base plate 11 may be connected to allow relative movement (this being the feature shown and described in Figure 1A of UK Application No. 8624419).

Figure 3 differs from Figure 1 in that the separate stem spring 12 and lock sleeve spring 18 have been replaced by a single spring 39 with a corresponding simplification of housing 13.

As shown in Figure 3 there is a spring 40 regulating movement as between drive plate 10A (and hence stem 10) and base plate 11 (and hence housing 13). This latter feature is also present in the embodiment described with reference to Figure 1, although not shown in the drawing.

While particularly useful for locking the plug and receptacle described in copending UK Application No. 8624119 it will be appreciated that the locking mechanism could be used with a wide variety of parts which require to be joined. All that is required is a drive plate with a push-pull action associated with a main junction plate. If necessary the drive plate could be actuated by a ROV or manually by a diver.

CLAIMS

1. A locking mechanism suitable for releasably locking two opposing faces by movement of the faces towards each other comprising

(a) a stem extending from a drive plate, said stem having on its circumference two annular projections and an adjacent profile,

(b) a lock sleeve around the stem, extending from a base plate separate from the drive plate, said sleeve having on its inner surface two projections and adjacent profile and on its outer surface a shoulder,

(c) a receptacle for receiving the stem and lock sleeve having a step on its inner surface and having a mouth of slightly smaller diameter than that of the stem and lock sleeve when the projections of each abut, so that as the stem and lock sleeve reach the receptacle, the lock sleeve is displaced axially relative to the stem so that its projections enter the stem profiles and vice versa thereby allowing entry of stem and lock sleeve until the shoulder of the lock sleeve engages the step of the receptacle, the projections of the stem and lock sleeve returning to an abutting position to lock the sleeve and stem into the receptacle.

2. A locking mechanism as claimed in claim 1 wherein the stem and lock sleeve are spring loaded so that in their rest position the projections on the stem and lock sleeve abut.

3. A locking mechanism as claimed in claim 1 or 2 wherein the projections on the stem and lock sleeve have sides sloping into the adjacent profiles.

4. A locking mechanism as claimed in claim 1, 2 or 3 wherein the end of the stem is conical or frusto-conical.

5. A locking mechanism as hereinbefore described with reference to the accompanying drawings.

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